BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

BIOGRACE – harmonisation of GHG methodologies

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BIOENERGY 2020+
European Biofuels Technology Platform,
4th Stakeholder Plenary Meeting, Brussels
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Renewable Energy Directive (RED)

Sustainability criteria for biofuels

- Minimum GHG emission savings (Art. 17.2)
  - 35%
  - for installations that were in operation on 23 January 2008: binding from 1 April 2013
  - 2017 50%
  - 2018 60% for new installations
- Economic operators may use (Art. 19.1)
  - default values
  - actual values calculated according to Annex V.C
  - sum of actual value and disaggregated default value
- Independent auditors must check information (Art. 18.3)

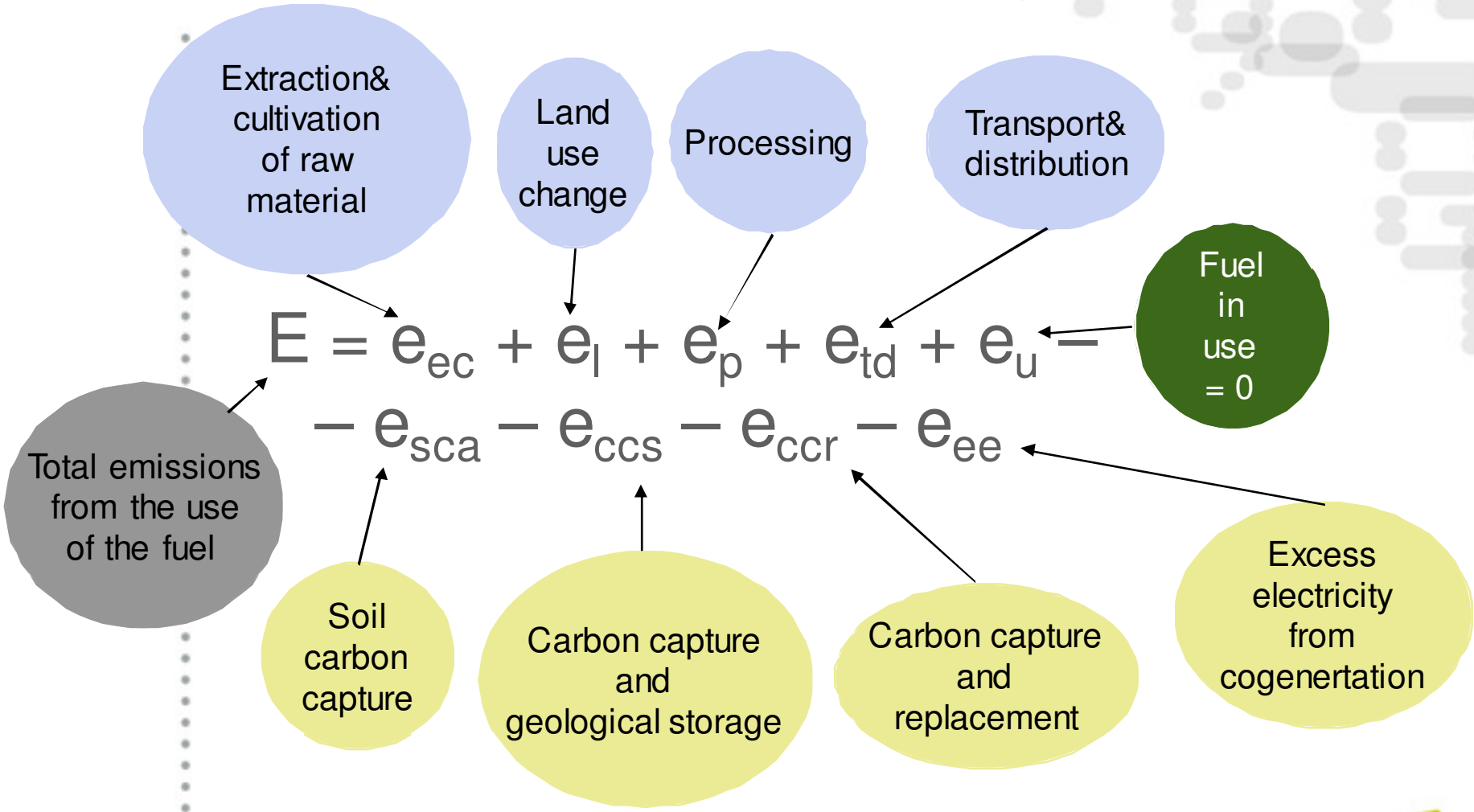
RED Annex V.a

Biofuel production pathway	Default greenhouse gas emission saving
– Ethanol from wheat (lignite CHP)	16%
– Ethanol from wheat (process fue	16%
– Ethanol from wheat (natural	%
– Ethanol from wheat (natur	
– Ethanol from wheat (straw	
– Ethanol from corn	%
– Ethanol from sugar beet	52%
– Ethanol from sugarcane	71%
– FAME from rape seed	38%
– FAME from palm oil	19%
– FAME from palm oil (methane capture)	56%
– FAME from soy	31%
– FAME from sunflowe	51%
– FAME from used	83%
– PVO from rape	57%
– HVO from rape	47%
– HVO from palm oil	26%
– HVO from palm oil (methan	65%
– HVO from sunflower	62%
– Biogas from dry manure	82%
– Biogas from wet manure	81%
– Biogas from MSW	73%

Ethanol from wheat (natural gas as process fuel in CHP plant) Default value: 47%

Rape seed biodiesel Default value: 38%

RED Annex V.c: Methodology



Why harmonisation of biofuel GHG calculations?

- Input data
- Standard values ("conversion factors")

Cultivation of rapeseed			Calculated emissions			
Yield			**Emissions per MJ FAME**			
			g CO_2	g CH_4	g N_2O	g $CO_{2,eq}$
Rapeseed	3.113	kg ha^{-1} $year^{-1}$				
Moisture content	10,0%					
By-product Straw	n/a	kg ha^{-1} $year^{-1}$				
Energy consumption						
Diesel	2.963	MJ ha^{-1} $year^{-1}$	6,07	0,00	0,00	6,07
Agro chemicals						
N-fertiliser	137,4	kg N ha^{-1} $year^{-1}$	9,08	0,03	0,03	18,89
CaO-fertiliser	19,0	kg CaO ha^{-1} $year^{-1}$	0,05	0,00	0,00	0,06
K_2O-fe						
P_2O_5-						
Pestic						
Seeding material						
Seeds- rapeseed	6	kg ha^{-1} $year^{-1}$	0,06	0,00	0,00	0,10

STANDARD VALUES	parameter:	GHG emission coefficient			
	unit:	gCO_2/kg	gCH_4/kg	gN_2O/kg	gCO_{2-eq}/kg
N-fertiliser		2827,0	8,68	9,6418	5880,6

Why harmonisation of biofuel GHG calculations?

EXAMPLE: Different results from same biofuel
("cherry picking" of the most beneficial standard values)

Parameter	Unit	Source			
		EC (RED Annex V)	**Netherlands** (Ecofys / CE)	**UK** RFA	**Germany** IFEU
Nitrogen Fertilizer	g CO_{2eq}/kg	5917,2	6367,0	6800,0	6410
P fertilizer	g CO_{2eq}/kg	1013,5	700,0	354 for TSP, **95** for rock phosphate, 596 for MAP	1180
K fertilizer	g CO_{2eq}/kg	579,2	453,0	333,0	663
CaO fertilizer (85%CaCO3+15%CaO,Ca(OH)2)	g CO_{2eq}/kg	130,0	179,0	124,0	297
Pesticides	g CO_{2eq}/kg	11025,7	17256,8	17300,0	1240
Diesel (direct plus indirect emissions)	g CO_{2eq}/MJ	87,6	76,7	86,4	89,1
Natural gas (direct plus indirect emissions)	g CO_{2eq}/MJ	68,0	53,9	62,0	62,8
Methanol (direct plus indirect emissions)	g CO_{2eq}/MJ	98,1	137,5	138,5	62,5

Why harmonisation of biofuel GHG calculations?

EXAMPLE: Different results from same biofuel
(same input values but different standard values)

Production of FAME from Rapeseed

Production of FAME from Rapeseed

Overview Results

All results in g CO_{2eq} / MJ_{FAME}	Total	Default values RED Annex V.D
Cultivation e_{ec}	**27,7**	**29**
Cultivation of rapeseed	**27,29**	28,51
Rapeseed drying	**0,42**	0,42
Processing e_p	**16,5**	**22**
Extraction of oil	**3,29**	3,82
Refining of vegetable oil	**0,85**	
Esterification	**12,39**	17,88
Transport e_{td}	**1,3**	**1**
Transport of rapeseed	**0,15**	0,17
Transport of FAME	**0,73**	0,82
Filling station	**0,44**	0,44
Land use change e_l	**0,0**	0
$e_{sca} + e_{ccr} + e_{ccs}$	**0,0**	0
Totals	**45,6**	**52**

Emission reduction

Fossil fuel reference (diesel)

83,8 g $CO_{2,eq}$/MJ

GHG emission reduction

46%

Emission reduction

Fossil fuel reference (diesel)

83,8 g $CO_{2,eq}$/MJ

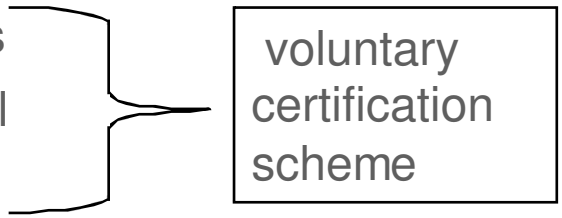
GHG emission reduction

38%

Project BioGrace

- **BIO**fuel **GR**eenhouse gas emissions: **A**lignment of **C**alculations in **E**urope
- Key objectives are
  1. Cause transparency
  2. Cause harmonisation
  3. Facilitate stakeholders

- Products
  1. One list of standard values
  2. Excel GHG calculation tool
  3. Calculation rules
  4. Harmonised national GHG calculators



Project BioGrace

BIOGRACE

Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe

Intelligent Energy Europe

One list of standard values

Version 3 - Public

STANDARD VALUES

parameter:

unit: gCO2/kg gCH

Global Warming Potentials (GWP's)		
CO2		
CH4		
N2O		
Agro inputs		
N-fertiliser	2827,0	8,6
P2O5-fertiliser	964,9	1,3
K2O-fertiliser	536,3	1,5
CaO-fertiliser	119,1	0,2
Pesticides	9886,5	25,5
Seeds- corn	-	
Seeds- rapeseed	412,1	0,9
Seeds- soy bean	-	
Seeds- sugarbeet	2187,7	4,6
Seeds- sugarcane	1,6	0,0
Seeds- sunflower	412,1	0,9
Seeds- wheat	151,1	0,2
EFB compost (palm oil)	0,0	0,0
Fuels - gasses		
Natural gas (4000 km, Russian NG quality)		
Natural gas (4000 km, EU Mix quality)		
Fuels - liquids		
Diesel		
Gasoline		
HFO		
Ethanol		
Methanol		
FAME		
Syn diesel (BtL)		
HVO		
Fuels / feedstock / byproducts - solids		
Hard coal		
Lignite		
Corn		
EFB		
Rapeseed		
Soybeans		
Sugar beet		
Sugar cane		
Sunflowerseed		
Wheat		
Animal fat		
BioOil (byproduct FAME from waste oil)		
Crude vegetable oil		
DDGS		
Glycerol		
Palm kernel meal		

	780	44,0
		26,5
		9,2
		18,5
		24,0
		26,4
		23,5
		16,3
		19,6
		26,4
		17,0
		37,1
		21,8
		36,0
		16,0
		16,0
		17,0

Condensed list of standard values, version 3 - Public

This file gives the standard values as published on www.biograce.net in Word format.

Two Word versions of this list exist:

1. A complete list of standard values, containing all the values as listed in the Excel version
2. A condensed list showing the most important standard values

This file contains the condensed list.

Abbreviations and definitions used can be found in the Excel file on the web page http://www.biograce.net/content/ghgcalculationtools/standardvalues.

1 Global Warming potentials

CO_2	1	g $CO_{2,eq}$ / g CO_2
CH_4	23	g $CO_{2,eq}$ / g CH_4
N_2O	296	g $CO_{2,eq}$ / g N_2O

2 GHG emission coefficients

N-fertiliser	5880,6	g $CO_{2,eq}$/kg N
P_2O_5-fertiliser	1010,7	g $CO_{2,eq}$/kg P_2O_5
K_2O-fertiliser	576,1	g $CO_{2,eq}$/kg K_2O
CaO-fertiliser	129,5	g $CO_{2,eq}$/kg CaO

Both Excel and Word versions available at www.BioGrace.net

One list of standard values

List of standard values

- is publicly available
- to be used by everyone that makes GHG calculations under RED based legislation

We are achieving this by:

- Including values in all software tools
- Causing that list is known by all GHG calculation experts
- Showing that these (and only these) standard values lead to RED defaults
- Requesting policy makers to make reference from national legislation (implementing RED / FQD)

One list of standard values

- European Commission put a link to the list
- Member States include list in Technical Guidance:
  - Denmark, Netherlands, UK have done so
  - Austria, Germany, Ireland, Portugal, Slovakia, Spain are planning to do so
- Example (from UK consultation on C&S Technical Guidance)
  - *The RFA therefore proposes the following approach to which standard values should be used:*
    1. For the reporting period 2011/2012, the RFA proposes to ***align its current standard emission factors with the ones proposed by the BioGrace project****.*

Energy: Biofuels: Sustainability Criteria - European commission - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

Euro-Referenz- und -Wechselkurse – Oe... | Publicações - Informa Economics FNP - C... | Energy: Biofuels: Sustainability Criteria -... | 4th Stakeholder Plenary Meeting of the ... | Screenshots unter Windows (leicht gem...

http://ec.europa.eu/energy/renewables/biofuels/sustainability_criteria_en.htm

screenshot tastenkombination

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Renewable energy

RSS

Biofuels: Sustainability Criteria

The Directive on renewable energy sets out sustainability criteria for biofuels in its articles 17, 18 and 19. These criteria are related to greenhouse gas savings, land with high biodiversity value, land with high carbon stock and agro-environmental practices. The criteria apply since December 2010. The Commission has adopted a number of decisions and Communications to assist the implementation of the EU's sustainability criteria.

Related documents

Legislation

Commission Decision on certain types of information about biofuels and bioliquids to be submitted by economic operators to Member States

Commission Decision on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC

Data layers on climate regions and soil type

Recognised voluntary sustainability schemes

Member States' reports on emissions from cultivation

Communications

Communication on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels

Communication on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme

Supporting documents

Annotated example of a GHG calculation [133 KB]

Annotated example of a land carbon stock calculation [596 KB]

Inventory of data sources and methodologies to help identify land status [3 MB]

Application of the sustainability criteria to the harvest of 2010 [402 KB]

Links

BIOGRACE project - List of standard GHG values

CEN/Technical Committee 383 draft standards prEN 16214-2 and prEN16214-3

Press room

Commission sets up system for certifying sustainable biofuels [IP/10/711, 10/06/2011]

Questions and Answers [MEMO/10/247, 10/06/2011]

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Quick jump
- EACI Agency
- Energy Eurobarometer
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- EU Calendar

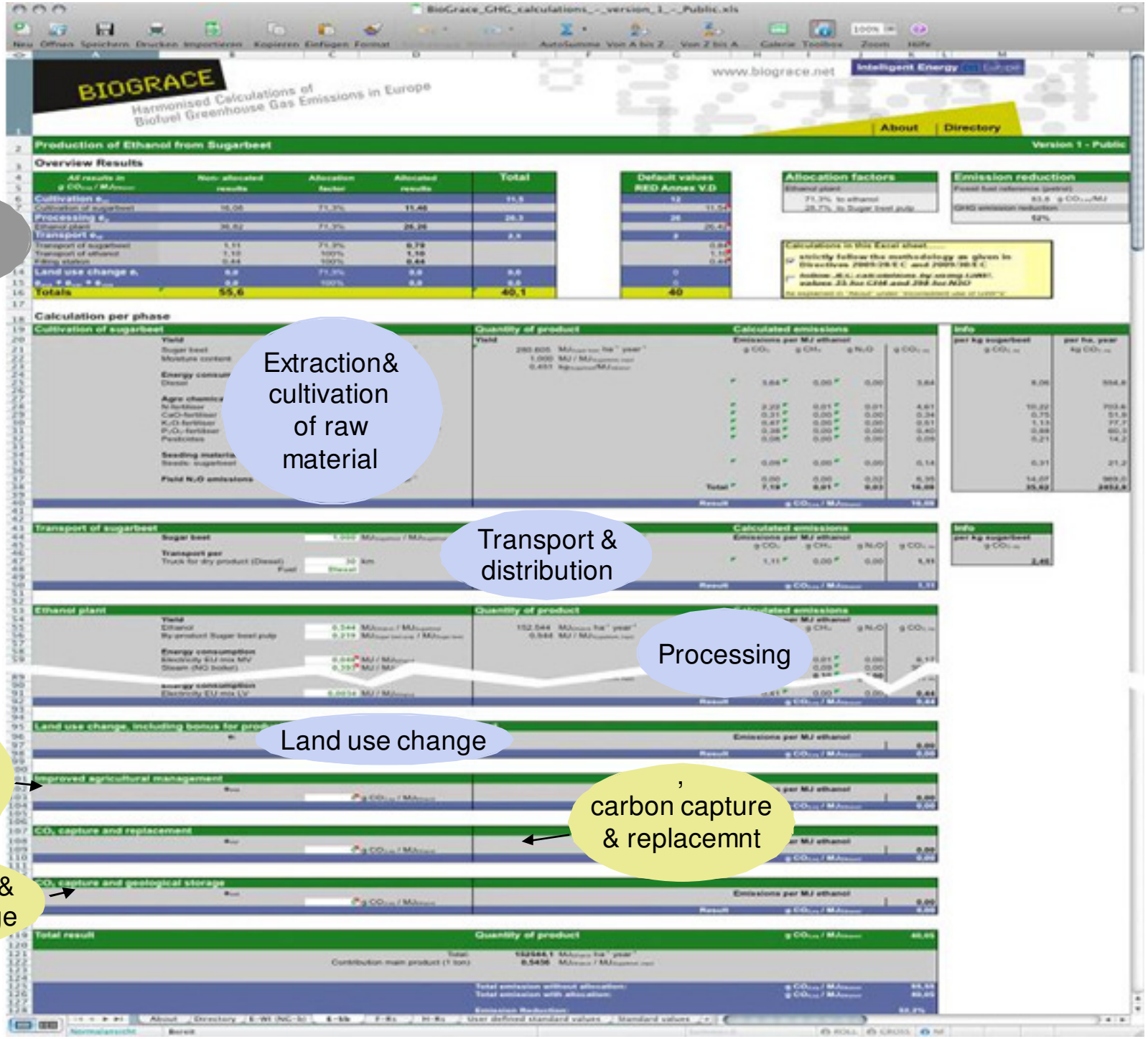
Calendar

[11/10] Second International Conference on Lignocellulosic Ethanol

[01/12] FP7 call "Smart Cities and Communities"

[08/03/2012] FP7 call "Energy Call Part 2"

The Excel tool



Total results

Extraction& cultivation of raw material

Transport & distribution

Processing

Land use change

Soil carbon capture

, carbon capture & replacemnt

Carbon capture & geological storage

The complete Excel tool

- **Version 4**
- One separate worksheet for each of the 22 biofuel pathways
- Standard values worksheet
- Separate worksheet for user defined standard values
- Extra worksheets for calculation of
  - direct land use change (based on Commission Decision)
  - carbon stock accumulation thanks to improved agricultural management (based on Commission Decision)
  - N_2O emissions (based on IPCC Tier 1)
- List of additional standard values
- User manual
- Calculations rules

„Future“ Biofuels

B. *Estimated typical and default values for future biofuels that were not on the market or were on the market only in negligible quantities in January 2008, if produced with no net carbon emissions from land-use change*

Biofuel production pathway	Typical greenhouse gas emission saving	Default greenhouse gas emission saving
wheat straw ethanol	87 %	85 %
waste wood ethanol	80 %	74 %
farmed wood ethanol	76 %	70 %
waste wood Fischer-Tropsch diesel	95 %	95 %
farmed wood Fischer-Tropsch diesel	93 %	93 %
waste wood dimethylether (DME)	95 %	95 %
farmed wood DME	92 %	92 %
waste wood methanol	94 %	94 %
farmed wood methanol	91 %	91 %
the part from renewable sources of methyl-tertio-butyl-ether (MTBE)	Equal to that of the methanol production pathway used	

BioGrace as a voluntary scheme

- EC approves voluntary certification schemes (RED Art. 18.4)
- BioGrace has submitted GHG tool to EC for recognition as a voluntary scheme in May 201; number 21 in the queue
- EC approved 7 schemes in July, 2011
  - ISCC: refers to BioGrace standard values
  - RTRS, 2BSvs allow for external GHG calculators
  - RSB: prescribes to use ecoinvent database
  - Bonsucro, Greenergy: do not require actual GHG values
  - RSBA's GHG methodology is not publicly available
- GHG tool can be used as "add-on" to existing schemes
- To our knowledge no other GHG tools have been send to Commission for recognition

Thank you for your attention

INTELLIGENT ENERGY EUROPE

The sole responsibility for the content of this presentation lies with the authors. It does not necessarily reflect the opinion of the European Union. The European Commission is not responsible for any use that may be made of the information contained therein.

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The aggregation box on top

from cultivation to filling station

Production of FAME from Rapeseed (steam from natural gas boiler)

Overview Results

All results in g $CO_{2,eq}$ / MJ FAME	Non- allocated results	Allocation factor	Allocated results	Total	Default values RED Annex V.D
Cultivation e_{ec}				28,9	29
Cultivation of rapeseed	48,63	58,6%	**28,49**		28,51
Rapeseed drying	0,72	58,6%	**0,42**		0,42
Processing e_p				21,7	22
Extraction of oil	6.53	58.6%	**3,83**		3.82
Refining of vegetable oil	1,06	95,7%	**1,02**		
Esterification	17,61	95,7%	**16,84**		17,88
Transport e_{td}				1,4	1
Transport of rapeseed	0,30	58,6%	**0,17**		0,17
Transport of FAME	0,82	100%	**0,82**		0,82
Filling station	0,44	100%	**0,44**		0,44
Land use change e_l	**0,0**	58,6%	**0,0**	**0,0**	0
$e_{sca} + e_{ccr} + e_{ccs}$	**0,0**	100%	**0,0**	**0,0**	0
Totals	**76,1**			**52,0**	**52**

BIOGRACE

Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe

Intelligent Energy Europe

RED Annex V.a

Biofuel production pathway	Typical greenhouse gas emission saving	Default greenhouse gas emission saving
– Ethanol from wheat (lignite CHP)	%	16%
– Ethanol from wheat (process fuel not specifie		16%
– Ethanol from wheat (natural gas steam boil		34%
– Ethanol from wheat (natural gas CHP)		47%
– Ethanol from wheat (straw CHP)		69%
– Ethanol from corn	%	49%
– Ethanol from sugar beet	61%	52%
– Ethanol from sugarcane		71%
– FAME from rape seed		38%
– FAME from palm oil		19%
– FAME from palm oil (methane capture)		56%
– FAME from soy		31%
– FAME from sunflower	58%	51%
– FAME from used cooking oil	88%	83%
– PVO from rape seed	45%	57%
– HVO from rape seed	51%	47%
– HVO from palm oil	40%	26%
– HVO from palm oil (methane capture)	68%	65%
– HVO from sunflower	65%	62%
– Biogas from dry manure	86%	82%
– Biogas from wet manure	84%	81%
– Biogas from MSW	80%	73%

Ethanol from sugar beet
Typical savings: 61%
Default value: 52%

Rape seed biodiesel
Typical savings: 45%
Default value: 38%

Land Use Change

General principles :

1. Annex V of the RED gives the general calculation guidelines (part C, point 7):

$$e_l = (CS_R - CS_A) \times 3{,}664 \times 1/20 \times 1/P - e_B \ (^1)$$

2. Calculation rules are explained in the following the decision 2010/335/EU: *Commission Decision of 10 June 2010 on guidelines for the calculation of land use carbon stocks for the purpose of Annex V of Directive 2009/28/EC.*

   This communication gives:

   - Consistent representation of land carbon stocks
   - Calculation rules
   - Default data for applying this formula (tables)

Land Use Change

General principles :

Two types of calculation are possible :

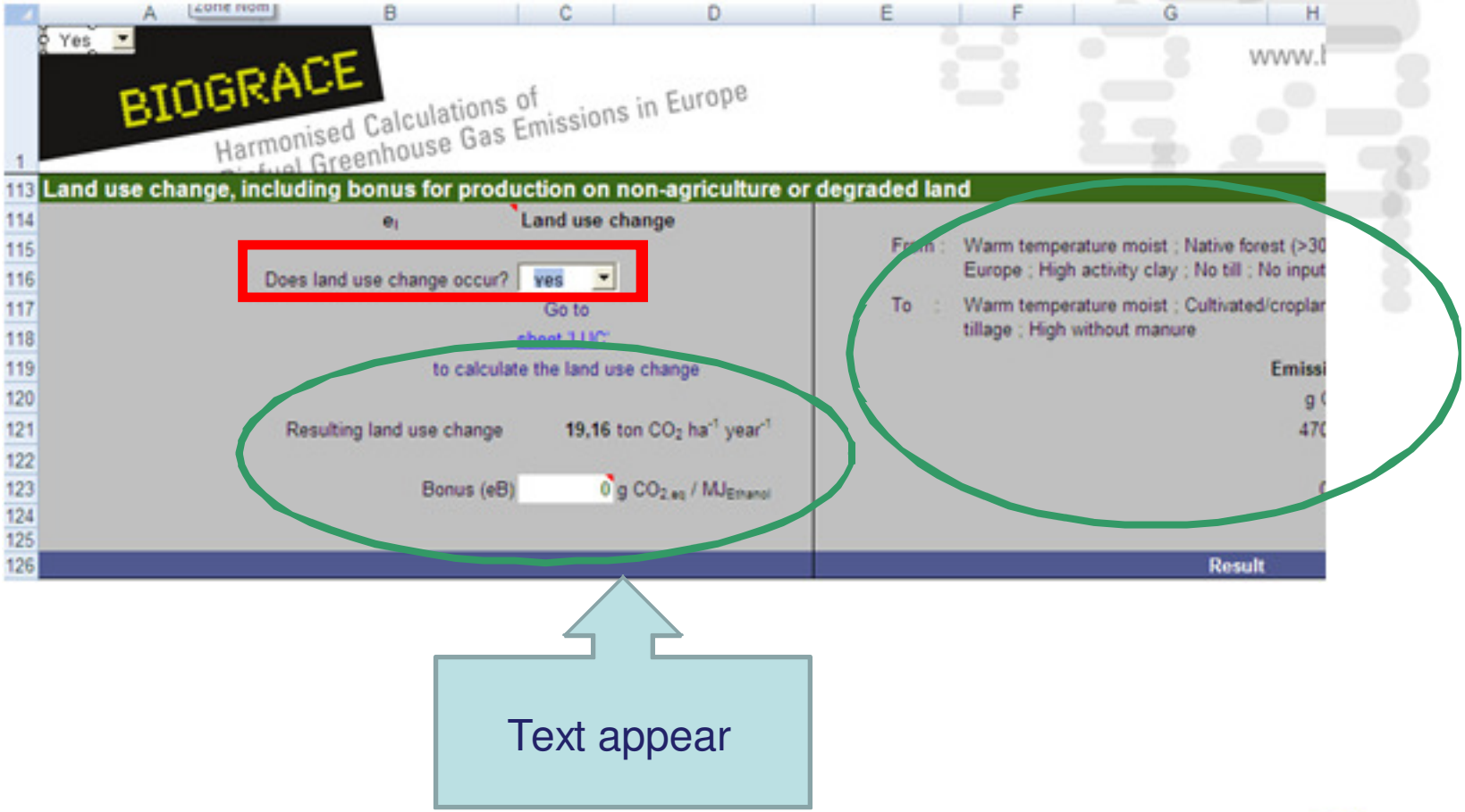
1. *Calculation using default value*

$$CS_i = C_{VEG} + SOC_{ST} * F_{LU} * F_{MG} * F_I$$

2. *Calculation using actual value for C_{VEG} and Soil Organic Carbon (SOC).*

$$CS_i = C_{VEG} + SOC_$$

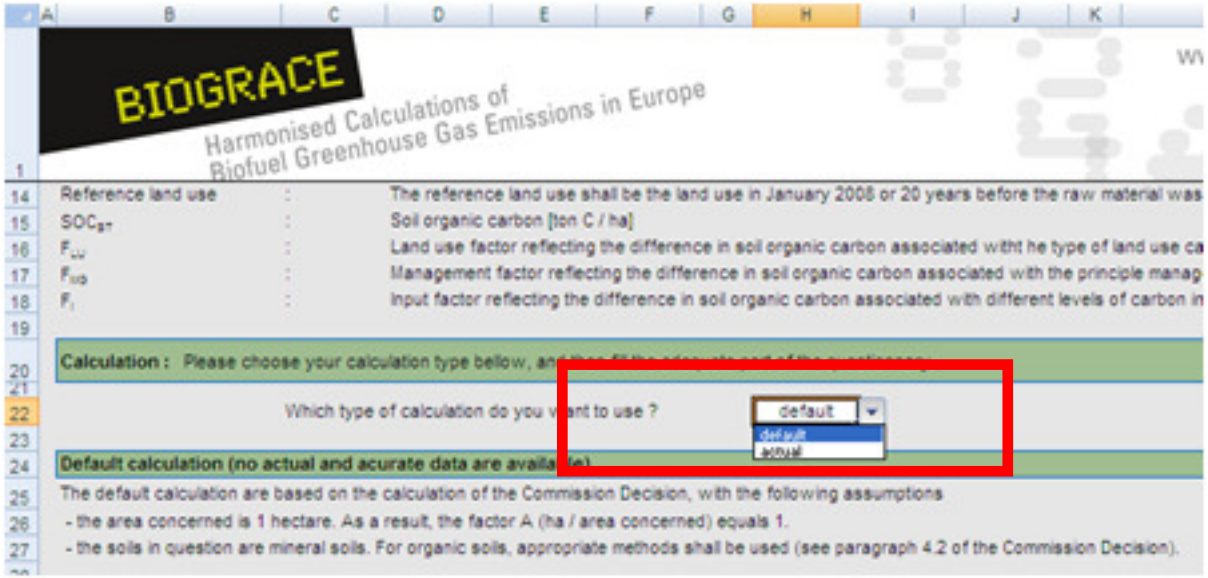
Step 1 : declare LUC in your pathway



Text appear

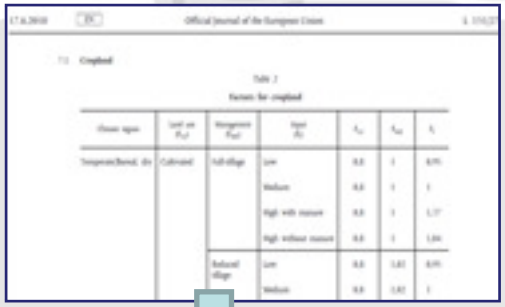
Step 2 : Go to the LUC excel sheet and read through this sheet. Get the Commission Decision 2010/335/EU with you.

Step 3 : Choose the type of calculation : default or actual and fill the appropriate white cells.



Step 4 (default calculation) : use EC decision to fill out data

		Actual land use	Reference land use
29	CS_A and CS_R are calculated with the following equation:	$CS_i = C_{VEG} + SOC_{ST} * F_{LU} * F_{MG} * F_I$	
30			
31			
32			
33	Climate region	Warm temperature moist	Warm temperature moist
34	Vegetation/crop (land use)	Cultivated/cropland	Native forest (>30% canopy cover)
35			
36	Above and below ground vegetation		
37	Ecological zone (if relevant)	-	Oceanic forest
38	Continent (if relevant)	-	Europe
39	C_{VEG}	0 ton C / ha	84 ton C / ha
40			
41	Carbon stock in mineral soil		
42	Climate region	Warm temperature moist	Warm temperature moist
43	Soil type	High activity clay	High activity clay
44	Soil management	Full-tillage	No till
45	Input	High without manure	No input
46			
47	SOC_{ST}	88 ton C / ha	88 ton C / ha
48	F_{LU}	0,69	1
49	F_{MG}	1	n/a
50	F_I	1,11	n/a



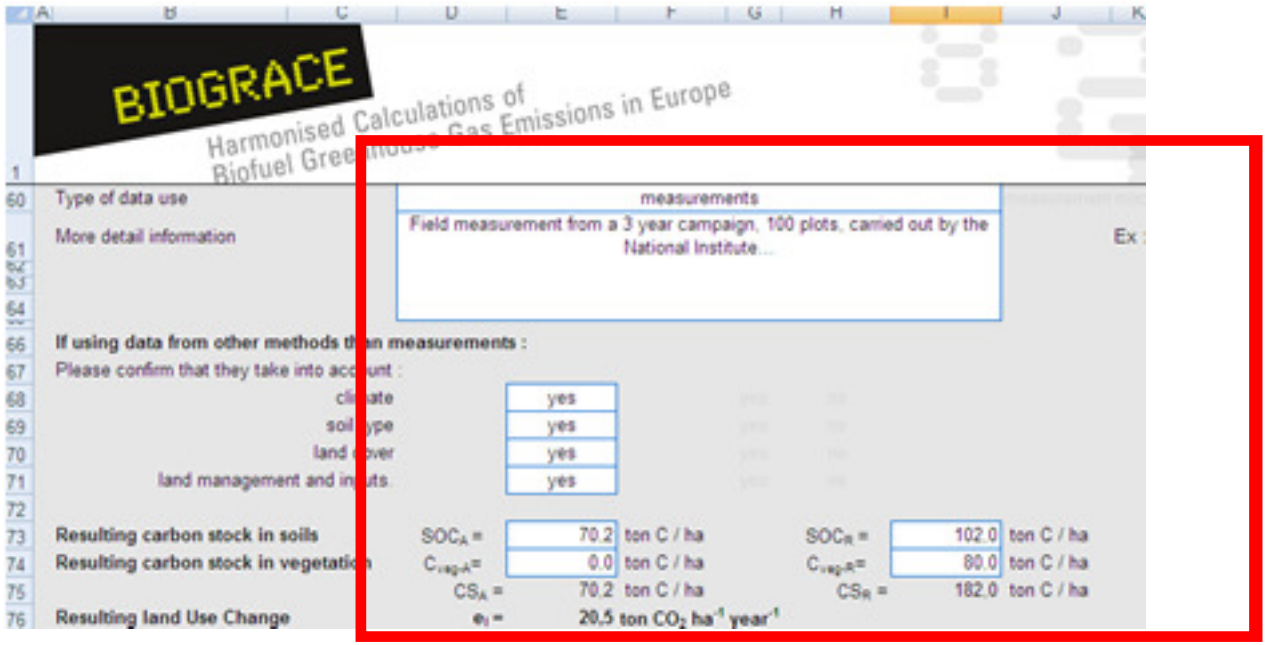
Calculate value according to Chapter 5, or look up val

Determine using paragraph 6.1 of Commission Decisio
Determine using paragraph 6.2 of Commission Decisio
Determine using table 3 of Commission Decision
Determine using table 3 of Commission Decision

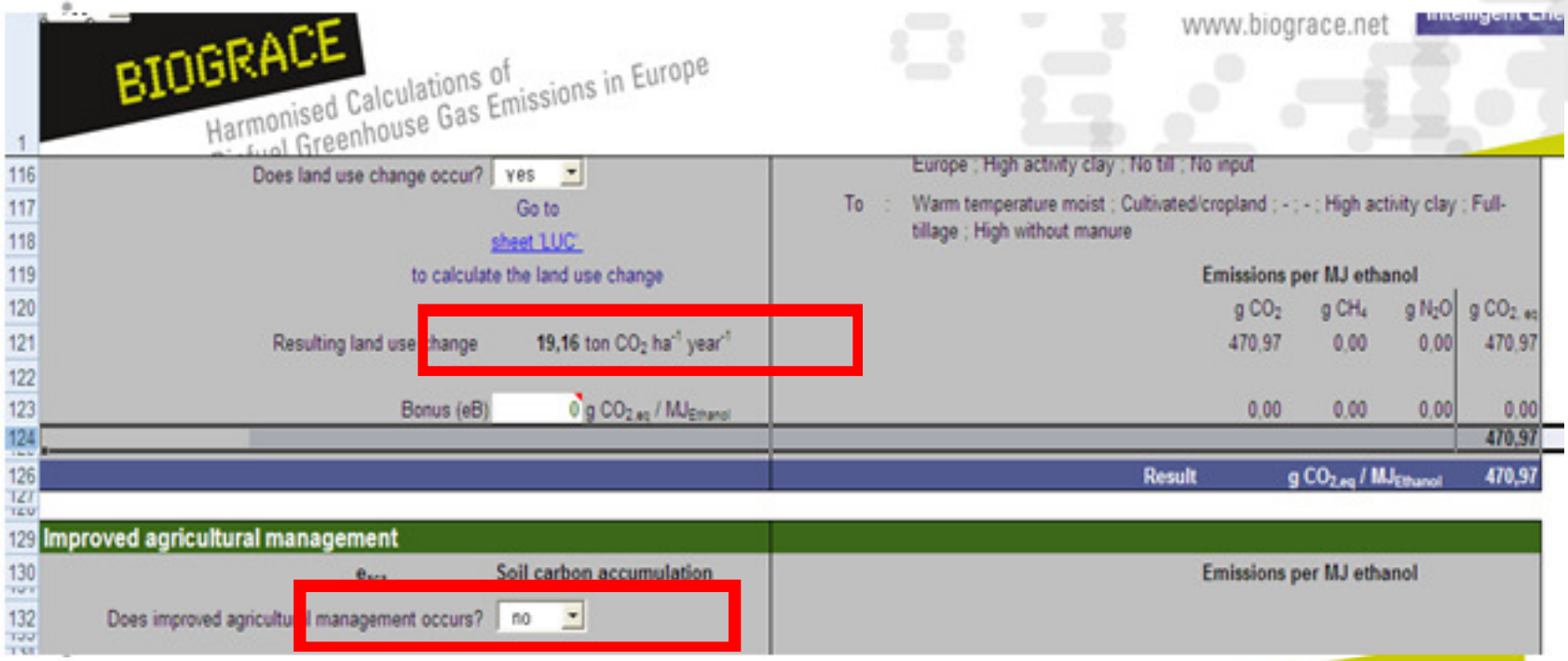
Loop up in Table 1 of Commission Decision, using clim
Look up in Tables 2 - 8 of Commission Decision
Look up in Tables 2 - 8 of Commission Decision
Look up in Tables 2 - 8 of Commission Decision

Resulting carbon stock	CS_A =	67.4 ton C / ha	CS_R = 172.0 ton C / ha
Resulting LUC	e_l =	19.16 ton eq. CO_2 / ha / an	

Step 4 (actual calculation) : mind filling detailed information on the sources of the SOC data used.

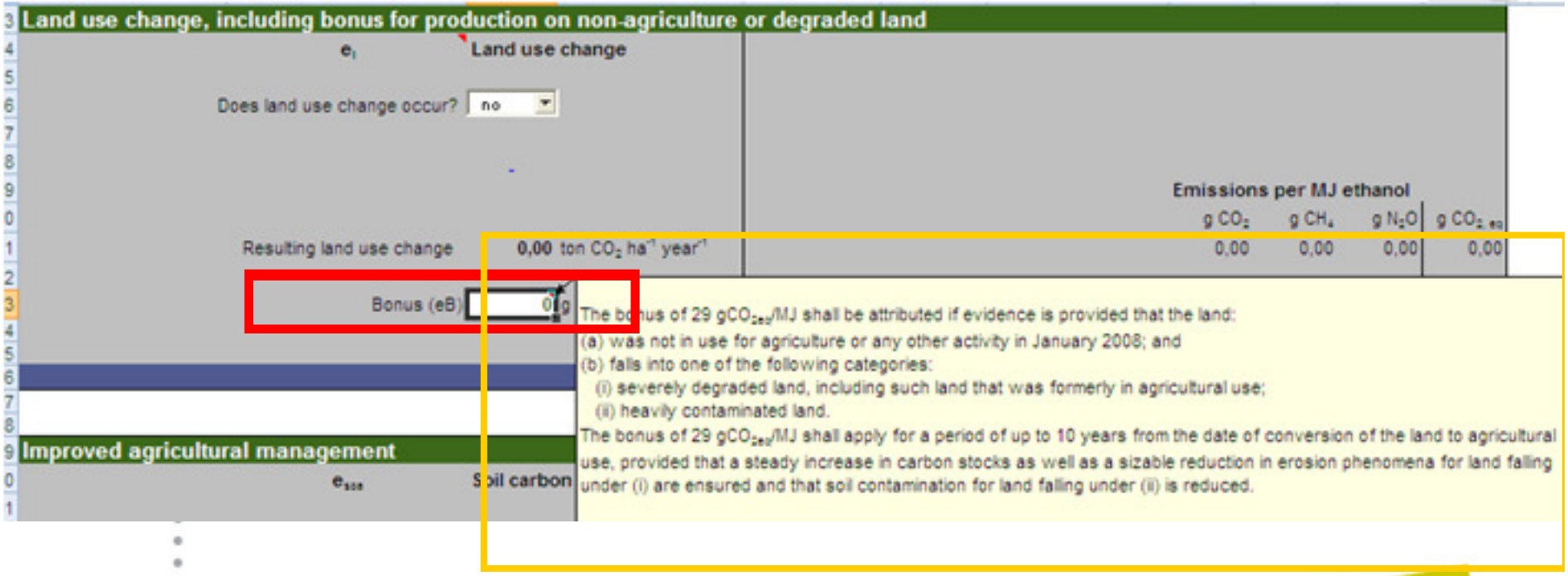


Step 5 : Check in the biofuel pathway that the LUC value is there. Please, also check that no Improved agricultural management is declared.



e_b bonus for degraded and contaminated lands :

- A specific line exits within the LUC module of each pathway.
- Explanations on how to use are to be taken from the RED



Improved Agricultural Management

1. Annex V of the RED has a specific term for carbon stock accumulation thanks to improved practices, but does not give much more explanations on how to calculate it
2. Calculation rules from the Commission Decision can serve as guidelines for making first level calculations
3. As for LUC, actual data can be used to assess them
4. In the BioGrace tool, an e_{sca} sheet exist to carry out the calculation
5. This sheet is build on the same frame than the LUC sheet
6. Don't declare e_{sca} when LUC are already declared (double counting)

New item in Public version 5

Calculation of N_2O field emissions

1. A major contributors to GHG emissions of most of the pathways
2. Default value : N_2O emissions calculated from a model (DNDC, average EU), except some pathways (IPCC Tier 1 for soybeans, palm trees, sugarcane)
3. For new pathways or when modifying the cultivation data from an existing pathways : BioGrace recommends to use IPCC Tier 1 estimation for this emission
4. BioGrace tool aims to provide an Excel sheet for making N_2O calculations